irrigation season coincides with the growing season for riparian vegetation, and the constant full pool has resulted in a fairly consistent band of riparian vegetation along much of the reservoir shoreline. Many species that occur for the Payette River also occur along the reservoir. The dominant riparian species growing along the reservoir shoreline is the exotic false indigo (*Amorpha fruticosa)*. This species is quite aggressive and in many areas has completely displaced native willows and other native species along the reservoir shoreline (BOR 2004).

The reservoir receives heavy recreational use between Memorial Day and Labor Day. Current recreational use numbers were not available but between October 1992 and September 1993, there were approximately 59,000 recreational visits, primarily for picnicking, water skiing and swimming. The BOR operates several parks and the county maintains several boat ramps. Recreational use includes boating, lake kayaking, fishing, swimming and jet skis.

Measurable oil and grease concentrations during periods of high reservoir use are predicted in shallower waters, which could result in slightly reduced spawning and feeding success by fish. The oil and grease is likely attributable to the use of two stroke engines on the reservoir. Recreational use also can increase turbidity levels.

Characteristics of Reservoir Zonation

In order to provide a clearer explanation of the water column data, reservoir characteristics are described in the following sections. Reservoirs combine qualities of both rivers and lakes, separating into zones called riverine, transitional, and lacustrine (lake-like) according to the reservoir basin shape and velocity of streamflow. Black Canyon is a run-of-the-river reservoir, meaning that it is dominated by riverine and transitional areas. The lacustrine zone is adjacent to Black Canyon dam.

The zones control the abundance and metabolism of algae and the way the system processes nutrients. The riverine zone is dominated by flow and mixing. In the riverine zone, algal abundance is more dependent on flushing than on in-reservoir nutrient concentrations. In the transitional zone, the inflow velocity slows, rapid sedimentation begins and water clarity increases. The lacustrine zone has thermal *stratification* and a higher probability of nutrient limitation of algal growth (Wetzel 2001). Thermal stratification is shown in Figure 36.

Characteristics of Reservoir Stratification

In the lacustrine zone of deep reservoirs, surface waters warm in the summer while bottom waters remain cool. Cold water is denser than warm water so the surface waters and bottom waters do not mix. The surface waters (epilimnion) continue to be mixed by wind, while the bottom waters (hypolimnion) do not mix with the upper layers of water. The middle layer is the area with the most rapid temperature change is termed the metalimnion or thermocline. This stratification is overturned by temperature and/or winds that cause mixing of the layers.

Generally, Black Canyon Reservoir does not stratify and when it does the stratification is for short periods, mainly in the lacustrine portion near the dam.

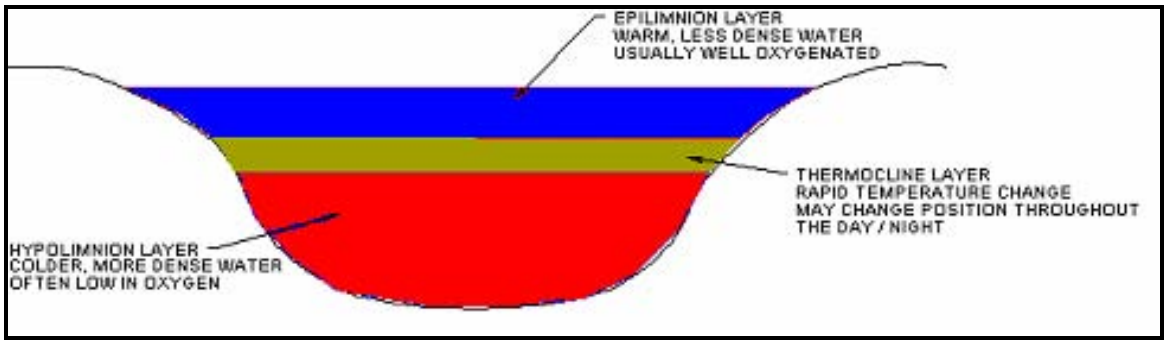

Figure 36. Depiction of a stratified lacustrine zone (summer condition).

Trophic Classification

Another tool for looking at reservoirs is trophic classification (Table 11). Trophic state refers to the overall level of nutrients and related algal and plant growth in the system. Eutrophication is the artificial increase in the trophic state of a system by human activities. The four major trophic classes are as follows:

- Oligotrophic-systems that have low supplies of nutrients
- Mesotrophic-systems with intermediate nutrient supplies
- Eutrophic-systems with a large supply of nutrients
- Hypertrophic-systems that have excessively large supplies of nutrients.

The following section on reservoir data shows that Black Canyon Reservoir is mesotrophic, indicating that Black Canyon Reservoir does not have excessive loading of nutrients.

Table 11. Lake/Reservoir Trophic Classification.

Classification	Average Planktonic Algal Chlorophyll (μg/L)	Average Secchi Depth (m)	Average In-Lake Total P (mg P/L)
Oligotrophic	< 2	> 4.6	<.00 79
Oligotrophic-mesotrophic	2.1-2.9	4.5-3.8	.008-.011
Mesotrophic	3.0-6.9	3.7-2.4	.012-.027
Mesotrophic-eutrophic	7.0-9.9	2.3-1.8	.028-.039

(Lee, 19

Water Column Data

Nutrients

Historic Black Canyon Reservoir data on nutrient impairment is sparse. Additional reservoir nutrient, chlorophyll-*a,* and dissolved oxygen information were collected by both DEQ and

BOR in 2004 to determine current nutrient loading and whether nutrient loading is impairing beneficial uses. DEQ and BOR monitored below where Squaw Creek enters the reservoir (station EMM080) and just north of the spillway (station EMM081). The reservoir below Squaw Creek is fairly shallow and consequently EMM080 is a more riverine site. The site at the spillway, EMM081, is the deepest and most lacustrine (lake-like) site.

Black Canyon Reservoir is a run-of- the -river reservoir and hydraulic retention time is short. Because the water flows through the system relatively quickly (i.e. the water volume is changed in the lake every 7 to 15 days) there is usually insufficient time for nutrients to be used for algae growth - the nutrients simply flow downstream to some other water body.

DEQ 2004 monitoring data showed an average concentration in the euphotic zone of 0.024 mg/L total phosphorus, which is below the 0.025 mg/L total phosphorus target. No algal blooms or excessive macrophyte growth was observed.

The 2004 chlorophyll *a* data from Black Canyon Reservoir at the spillway site (EMM081) falls within the range for mesotrophic water bodies (Table 8). Mesotrophic water bodies are biologically productive and slightly green. These water bodies can be said to have moderate amounts of nutrients. Chlorophyll-*a* concentrations at EMM081 ranged between 1.7 µg/L to 6.5 µg/L which are below the 10 µg/L target. The average chlorophyll-*a* concentration from late April through September was 3.51 µg/L which is also below the EPA reference condition of 4.7 µg/L.

Beneficial uses, particularly cold water aquatic life and recreational uses, are not impaired due to nutrients.

The Idaho temperature standard for lakes and reservoir states: 'temperature in lakes shall have no measurable change from natural background conditions. Reservoirs with mean detention times of greater than fifteen days are considered lakes for this purpose.' Black Canyon's low hydraulic retention time (<15 days) means that the numeric temperature criteria for rivers/streams apply rather than temperature standards for lakes and reservoirs (No greater than 22 degrees Celsius AND no greater than 19 degrees Celsius maximum daily average). For this TMDL, temperature will be averaged in the livable space (in the meters of habitat where there is greater than 6.0 mg/L of dissolved oxygen). This method takes into account the fact that even though surface temperature may be high, livable space and refuge for fish may exist in deeper water. Using this approach, temperature was below the state standard until late July at the more lacustrine station, EMM081, but met criteria at the more riverine station, EMM080. Throughout the summer, livable space existed in the upper portion of the reservoir.

In late July, temperature violations were seen in part of the water column at EMM081. pH measurements met the state standard but showed an increase from the bottom of the water column (6.68) to the surface (8.10). This increase could be tied to algal activity in the euphotic zone (light penetration zone). Figure 37 is a schematic of the reservoir during the summer sampling months.

Throughout spring and through mid-July, dissolved oxygen levels met state water quality standards at both stations. On July 21 temperatures were above the 22° C standard in the top

6.7 meters of the water column and dissolved oxygen concentrations were below 6 mg/L in the bottom 6 meters of the water column. Between 6.7 and 7.7 meters on that sampling date, there was a thermocline (the demarcation zone between the warmer and colder layers of water). In other words, between 6.7 meters and 7.7 meters there was a change in temperature of 1° C. The colder water is denser than warmer water causing the two layers to remain distinct until either wind or cooler ambient temperatures causes mixing.

Since Idaho standards state that the 6 mg/L dissolved oxygen criterion does not apply to the hypolimnion of stratified lakes and reservoirs, no violation of dissolved oxygen standards occurred on July 21.

By mid-August (the next sampling event), temperatures were below the state standard and dissolved oxygen violations occurred in the bottom seven meters but were above 6 mg/L throughout the rest of the water column. Stratification was no longer present. By the following week, dissolved oxygen levels and temperature both met the state standard. Thus, portions of the reservoir may be vulnerable to not supporting cold water fisheries in mid-summer particularly during periods of high ambient air temperatures. The lacustrine section of the reservoir near the dam was likely in violation of state standards for temperature periodically during a three week window of high ambient temperatures. However, the more riverine portion of the reservoir met the temperature standard, providing suitable fisheries habitat.

In mid-August, evening and pre-dawn dissolved oxygen monitoring was initiated to investigate the occurrence of dissolved oxygen sags. This monitoring showed that while oxygen levels decreased at night, they did not fall below the state standard. This is further evidence that nutrients are not in excess because dissolved oxygen sags, driven by plant production and die-off, are not evident.

August 2003 monitoring showed violations of the dissolved oxygen and temperature standards. However, there was a band of several meters of habitat with temperature and oxygen levels that met the state standard.

The station below Squaw Creek did not show temperature or dissolved oxygen violations at any time during the sampling season. This section is much shallower and more riverine than the lakelike station just north of the dam and does not stratify.

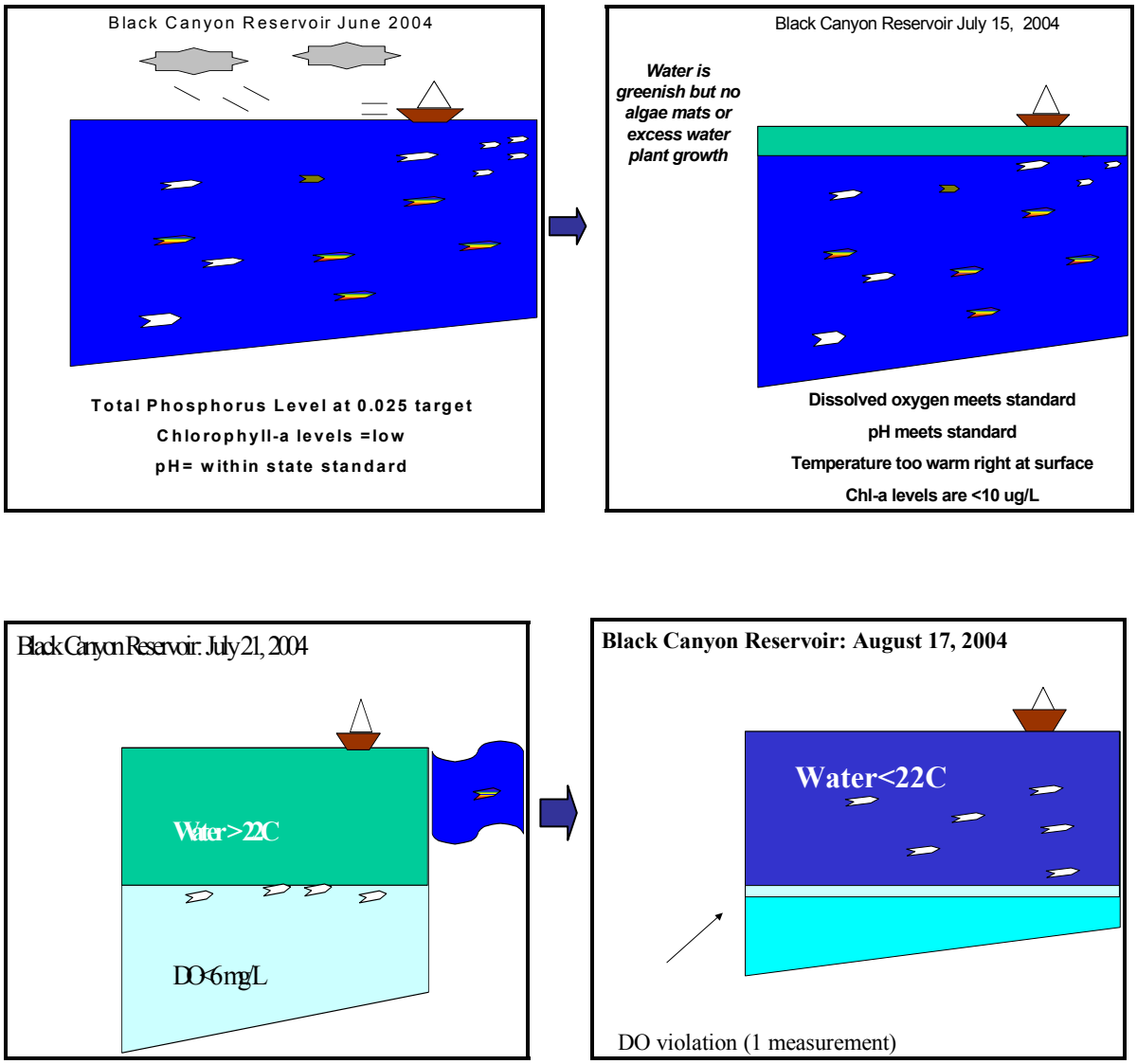

Figure 37. Schematic of Reservoir Conditions Near Dam.

Water clarity is reduced in Black Canyon Reservoir and phytoplankton are evident, but nuisance algal growth as manifested by floating mats or thick macrophyte colonies are not present. Average Secchi depth, a measurement of water clarity, was 2.1 m over the 2004 sampling season, indicating mesotrophic-eutrophic conditions.

Black Canyon Reservoir does not have habitat for salmonid spawning. Reservoirs typically do not contain salmonid spawning habitat due to depth and reduced water velocity. However, tributaries within the watershed are available for fish spawning. No fish kills were reported during the 2004 sampling season.

North Fork Payette River Nutrient Loading

Reservoir nutrient loading was investigated to determine if nutrient concentrations were above target levels in the Payette River. During 2004, March through September total phosphorus concentrations in the North Fork Payette River at Montour Bridge (the closest river monitoring site to Black Canyon Reservoir) averaged 0.04 mg/L (Figure 38). November 2003-September 2004 concentrations averaged 0.033 mg/L. Not only are these

concentrations below the EPA Gold Book criterion of 0.05 mg/L, but also they are below the ecoregional nutrient reference condition criteria for subecoregion 12 of 0.043 mg/L (EPA 2000a), meaning that concentrations are comparable to those seen in minimally impacted rivers. The highest total phosphorus concentrations were seen during the first spring runoff events with the highest total phosphorus concentrations and loading attributable to the South Fork Payette River (Figure 39).

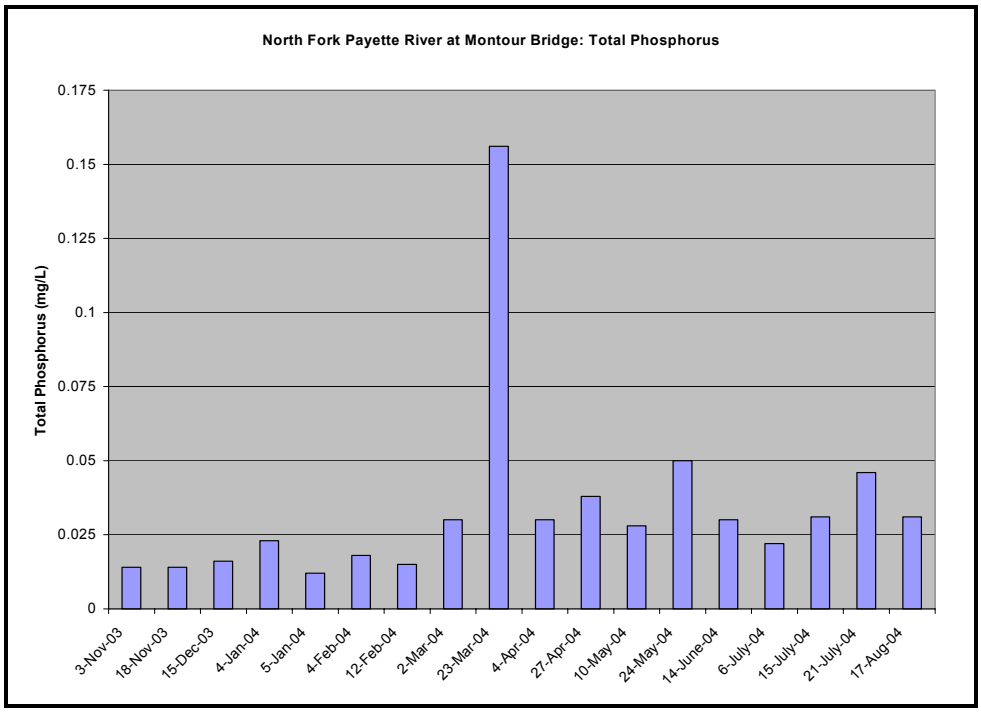

Figure 38. Total Phosphorus Concentrations: Montour Bridge, NFPR 2004.

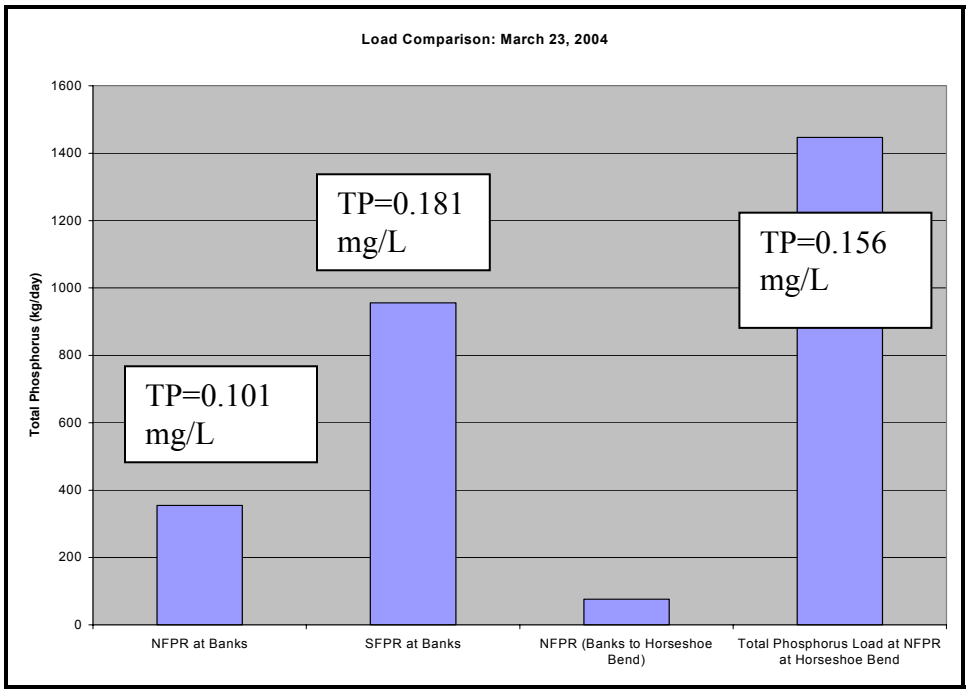

Figure 39. Phosphorus Load: N. Fork Payette River and S. Fork Payette River, 2004.

Sediment

The geometry of Black Canyon reservoir causes water velocity to decrease and sediment to fall out of the water column. Sediment is of particular concern in reservoirs if heavy metal/*pesticide* accumulation or nutrients attached to sediment are a problem in the reservoir system. Black Canyon reservoir does not appear to have nutrient problems associated with the sediment. Data from 1991 and 1997 did not detect mercury, lead or arsenic. No organochlorine or other pesticide data was available. Agricultural activity is mainly centered around pastureland with a small percentage of cropland. Pesticide contamination is not expected to be impairing beneficial uses.

While Black Canyon Reservoir has shown the effects of sedimentation in terms of decreased cold water fishery habitat and changes in reservoir depth, actual sediment loading from the North Fork Payette River is minimal when compared to the South Fork Payette River. However, mass wasting events do occur in the North Fork Payette drainage on an infrequent basis and these events may contribute large amounts of sediment to the reservoir. The Horseshoe Bend Hydroelectric company annually removes a large quantity of sediment from their flow through diversion (i.e. the water reenters the river), which also decreases the amount of sediment entering the reservoir.

The 2004 BOR Resource Management Plan discussed sedimentation of the reservoir due to localized sediment contribution but did not quantify sediment contribution from bank erosion. The plan stated that soils in the watershed just upstream of the reservoir show negligible erosion; however, a few soil series have a slight to moderate risk of water erosion, although this problem is not widespread. Erosion is most prevalent along the Black Canyon Reservoir shoreline from boat wake generated wave action. The only location with an ongoing erosion problem is the shoreline at Black Canyon Park. BOR has attempted to

protect the shoreline from additional erosion using rock riprap, but erosion continues on the north and south ends of the riprap area. In the future, trees growing above the eroding area may fall into the reservoir because of bank failure (BOR 2004).

Black Canyon Reservoir is designated for salmonid spawning. The reservoir due to its deeper water, low velocity, and sandy substrate does not provide spawning habitat. However, spawning habitat exists upstream of the reservoir and this can be utilized by salmonids. The issue is not that of a pollutant impairing salmonid spawning, but instead reservoirs simply do not provide the habitat conditions necessary for salmonid spawning.

Sediment Loading: North Fork Payette River below Smiths Ferry

Suspended sediment concentrations averaged less than 25 mg/L over the monitoring season as measured at the inflow location to Black Canyon Reservoir at Montour Bridge, thus, meeting the sediment target (Figure 40). Figure 41 shows the suspended sediment contribution that the South Fork Payette River makes to the Main Payette River. The bulk of sediment loading comes from the South Fork Payette River watershed. This loading is visually represented in Figure 42 below. While both the North and South Fork Payette Rivers are subject to mass wasting events, these events occur more frequently in the South Fork Payette drainage. The North Fork Payette River drainage meets suspended sediment targets and thus does not load excess suspended sediment to Black Canyon Reservoir. Even when mass wasting events occur, concentrations over a 30-day period likely meet the 50 mg/L suspended sediment concentration target. A sediment TMDL was determined for the North Fork Payette River to prevent excess bedload sediment from being delivered to the Cabarton Reach.

The South Fork Payette River Subbasin Assessment determined that bedload sediment did not adversely affect the South Fork Payette River due to velocities that would transport bedload out of the system. The bedload delivered to the Main Payette was deterimined to be from natural sources and a TMDL was not developed (IDEQ 2004a).

The South Fork Payette River is estimated to be a significantly higher contributor of bedload sediment to Black Canyon Reservoir than the North Fork Payette River.

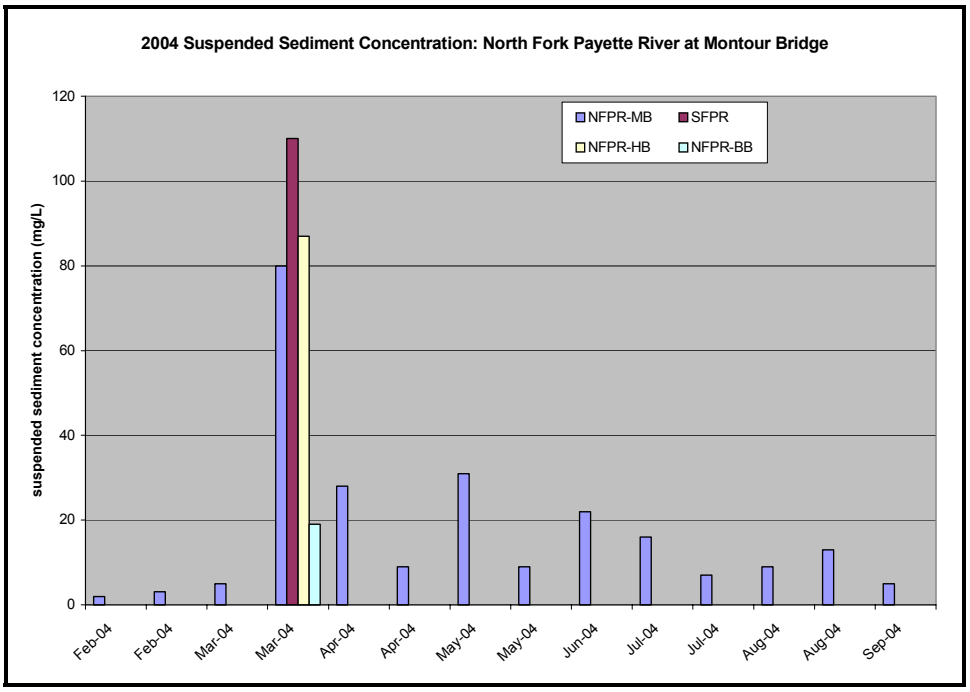

Figure 40. 2004 Suspended Sediment Concentrations: North Fork Payette River at Montour Bridge .

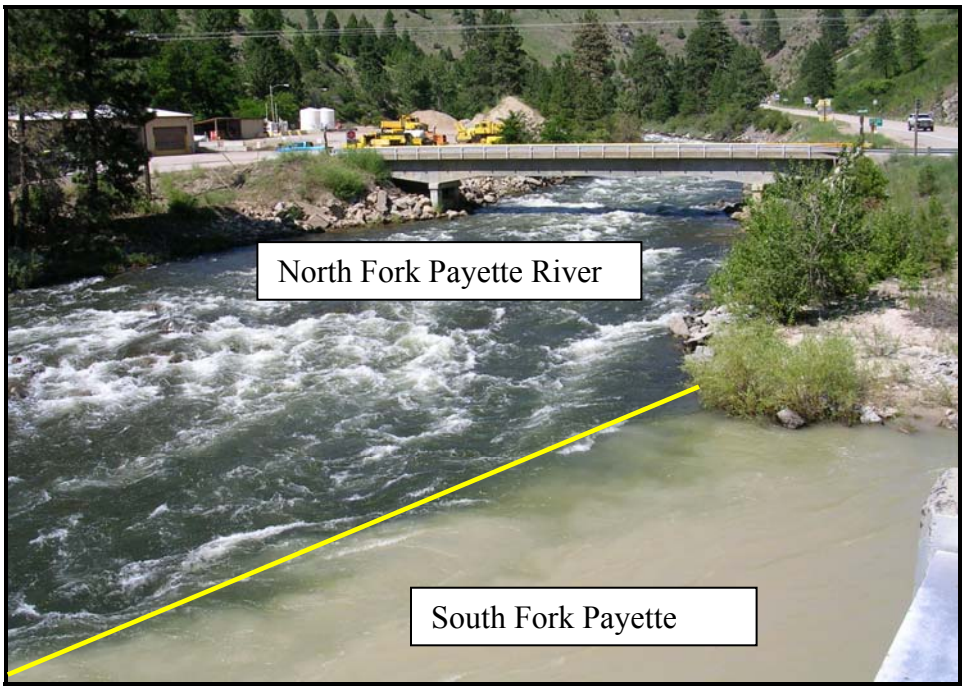

Figure 41. Confluence of the North Fork and South Forks of the Payette River After a Mass Wasting Event along the South Fork Payette River, 2004.

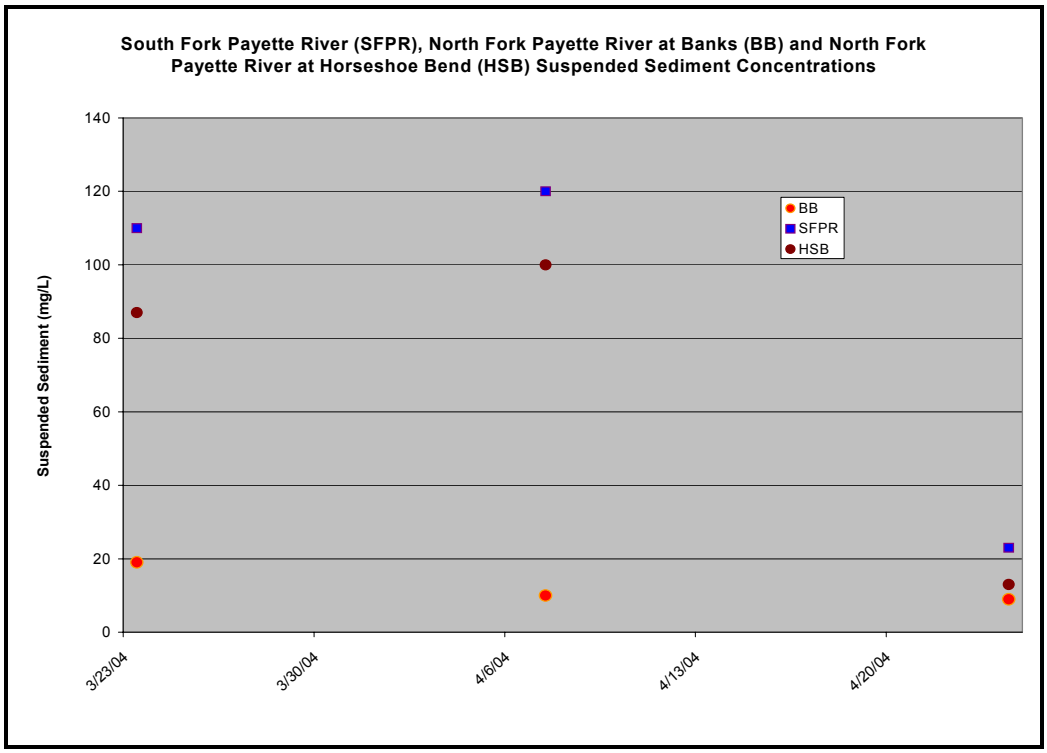

Figure 42. 2004 Total Suspended Sediment Concentrations: North Fork Payette River and South Fork Payette River.

Since suspended sediment concentrations from the North Fork Payette River meet TMDL targets for sediment in riverine systems, suspended sediment will be proposed for de-listing from the 303(d) list (Figure 42). The reservoir will be placed in Section 4.c.of the 303(d) list for habitat alteration caused by legacy sediment deposits.

Oil and Grease

DEQ sampled twice for oil and grease in recreational areas (Black Canyon Park and Triangle Park) during July 2004 to determine if oil and grease were a problem, because those were the only areas where any sheen from oil and grease was noticeable. Of the two sample sets in July, one set came back below the detection the limits while the July 15th set showed oil and grease concentrations of 1.4 mg/L at Black Canyon Park and 9.9 mg/L at Triangle Park. The 9.9 mg/L result is above the 5 mg/L target. This 9.9 mg/L sample triggered another round of sampling.

The next sampling events were taken throughout the reservoir to avoid biasing the results by taking them at recreational areas where concentrations would be the highest. DEQ re-sampled for oil and grease in October by taking two measurements (one on the north side of the reservoir and one on the south side) every longitudinal mile in the reservoir. This sampling event was at the tail end of the recreational use period, so oil and grease may have been underestimated. However, if oil and grease concentration had accumulated in the reservoir over the course of the summer, the sample concentrations would reflect that accumulation. The results came back less than 1.3 mg/L, or below the 1 mg/L detection limit for all samples.

The results of the second round of oil and grease sampling showed in-reservoir concentrations that were all below 5 mg/L, oil and, thus, grease is recommended for de-listing.

Conclusions

Black Canyon Reservoir is listed on the 1998 303(d) list for sediment, nutrients, and oil/grease. The inflow to the reservoir from the North Fork Payette River system meets nutrient and sediment TMDL targets. Although the reservoir is stressed during the hottest time of the year due to a combination of climactic and low flow conditions, overall, beneficial uses are not impaired. Warm summer temperatures rather than excess nutrients appear to be the main stressor on cold water fisheries. However, areas of cooler water exist in the upper portions of the reservoir during these times.

While a TMDL is not required at this time, if significant land use changes occur, monitoring needs to occur to ensure that the river system continues to meet nutrient/sediment targets and support beneficial uses. Nutrients are recommended for removal from the 303(d) list.

Oil and grease are not impairing the reservoir. The use of motorized watercraft on the reservoir can result in visible petroleum hydrocarbons on the surface. However, the distribution of the hydrocarbons is likely temporally and spatially highly variable. Oil and grease is recommended for de-listing.

Sediment deposition in Black Canyon Reservoir occurs due to the decrease in flow that occurs as a result of Black Canyon's geometry. The reservoir naturally functions as a sediment basin. Sedimentation has affected river morphology upstream resulting in changes in the floodplain near Montour. Currently, the Middle Fork Payette River has a sediment TMDL in place. Levels of sediment in the South Fork Payette River were determined to be at natural background levels and are expected to be at much higher loads than those from the North Fork Payette River. This is because the North Fork Payette River is hydrologically modified due to Cascade Dam and subsequently has dam controlled flows that prevent peak flushing flows from occurring in this section. A bedload TMDL has been determined for this section of the North Fork Payette River. With sediment TMDLs in place upstream, sediment is not being delivered to the reservoir over background levels. A TMDL is not necessary.

Box Creek

Originating at 8,653 feet off of Beaverdam Peak, Box Creek flows approximately 4.5 miles before entering the North Fork Payette River at 5,020 feet, approximately 8 miles north of McCall, Idaho (Figures 43 and 44). Much of the upper portion of the drainage was burned in the Blackwell fire in the summer of 1994 (Figure 43). The 5,667-acre Box Creek watershed has several alpine lakes present in its headwater area with Box Lake being the largest in size. Land ownership is primarily state, managed by the Idaho Department of Lands (IDL), with some small areas of Bureau of Land Management and National Forest managed public land (IDL 2003a).

Box Creek is a 3rd order tributary, with a dendritic stream feeder pattern, to the North Fork Payette River. The upper reach is a Rosgen type A stream characterized by a narrow channel and a step/pool bed morphology. The drainage is oriented in a westerly direction

with side tributaries entering mostly from the north and south. While Box Lake is a natural lake, it does have a dam on it for irrigation purposes. The lake impounds 1,300 acre-feet of water. Box Lake has not been stocked since 1971 but has a resident brook trout population. Rainbow trout are found in the lower reaches of Box Creek.

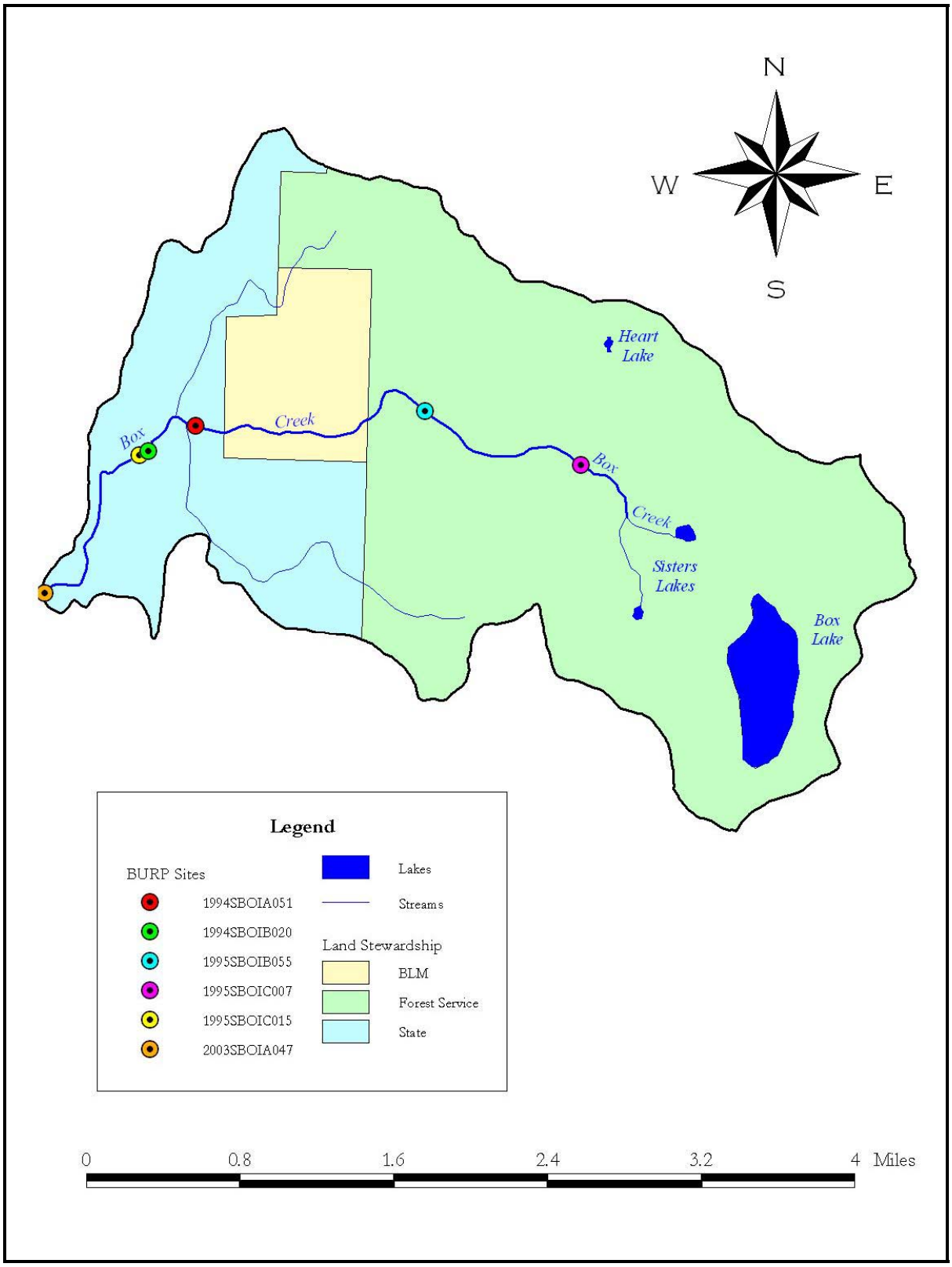

Figure 43. Box Creek Land Stewardship and Monitoring Sites.

Figure 44. Box Lake.

The Box Creek drainage is predominantly underlain by variously weathered granitic rocks of the Idaho Batholith. To a lesser extent the drainage is underlain by *loess*. These granite rocks are typically divided, with the highly weathered material occurring along the lower elevations and dominating the main stem flood plain and lower tributary flood plains. The weakly weathered material occupies the uplands and ridgelines. The headwater area has substantial amounts of exposed bedrock, cliffs and talus slopes (IDL 2003).

The area is characterized by an average annual precipitation of 50 inches at both the lower and higher elevations. The majority of precipitation occurs as winter snowfall and spring rain. High-volume runoff occurs during spring snowmelt and major rain-on-snow events. Vegetation varies with elevation and aspect. Lower elevations support a mixed conifer forest stand with Douglas fir, hemlock, western larch and tamarack, with inclusions of Englemann spruce near streams and wetter areas. The presence of lodgepole pine, subalpine fir and pockets of spruce increase with elevation (IDL 2003). The understory is primarily mallow ninebark, pine reedgrass and snowberry.

Flow Characteristics

Peak flows in Box Creek usually occur in May or June and base flows by late October (Figure 45). Box Creek flows are managed for irrigation purposes and there is a dam at the outlet of Box Lake.

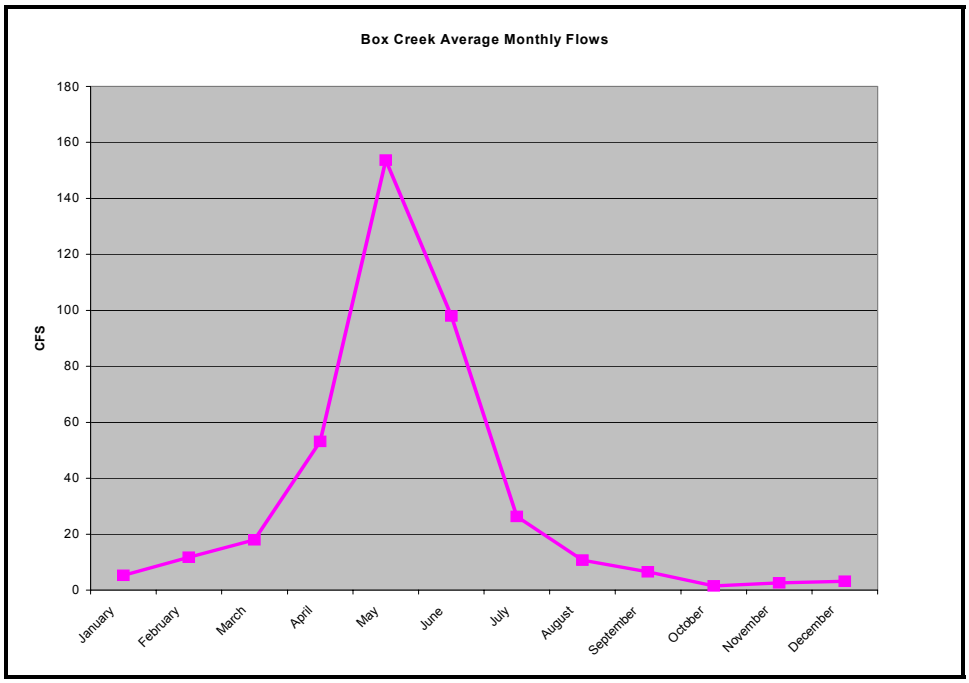

Figure 45. Box Creek Average Monthly Flows (DEQ 1997).

Biological/Habitat Data

Box Creek was assessed as unimpaired in every reach sampled as part of DEQ's BURP process (Table 12). For the 1997 study of Big Payette Lake, the Box Creek macroinvertebrate metric scores were used as regional reference criteria for the Big Payette Lake watershed. DEQ macroinvertebrate (SMI), habitat (SHI) and fisheries (SFI) scores were all high (3 is the highest possible score), indicating that beneficial uses are not impaired. However, salmonid spawning is a designated use in Box Creek, so additional temperature monitoring was initiated to ensure that beneficial uses were not impaired during the salmonid spawning season. The results are discussed in the following temperature section.

Table 12. Box Creek: DEQ Water Body Assessment Scores.

Stream ID	SHI	SMI	SFI	Water Body Assessment Score	Beneficial Use Support Status
1994SBOIA051	3	3	No data	3	Full Support
1994SBOIB020	1	3	No data	2	Full Support
1995SBOIC007	3	2	No data	2.5	Full Support
1995SBOIB055	1	3	No data	2	Full Support
1995SBOIC015	1	3	No data	2	Full Support
2003SBOIA047	3	3	3	3	Full Support

Box Creek is managed for timber harvest. Most historic tree harvest activity used ground-based tractor skidding and some of this occurred in stream protection zones. Old skid trails

that were in stream protection zones have substantial vegetative recovery and cannot be used in the future under current *Idaho Forest Practices Act* (FPA) rules. New skid trails are outside stream protection zones, resulting in very little delivery of sediment to stream channels. Salvage logging occurred in 1995-96 after the fire.

A Cumulative Watershed Effects (CWE) analysis was done for Box Creek in 1995 by the Idaho Department of Lands. Two 1,000 feet stream reaches in the Box Creek drainage were evaluated for channel stability in June 1995 when stream flows were low. The results are summarized in Table 13. This channel stability assessment looks at bank cutting, bank rock content, bank sloughing, riparian zone bank protection, large woody debris and channel substrate characteristics.

The reach with the highest score is used for the CWE channel stability rating because this is the area most susceptible to disturbance from potential increases in peak flows. The assessment identified some bank sloughing, reduced vegetative bank protection, moderate bank rock content, some bank cutting, lack of large organic debris, channel bottom movement, and channel bottom rock shape/roundness all contributing to the moderate rating.

A roads analysis calculated that the entire Box Creek watershed contains approximately 8 miles of roads, all of which are within forestry land use areas. Approximately 0.6 miles of roads were evaluated using the CWE road assessment. The road evaluation emphasized roads that are close to streams and those considered to have a high potential to impact water quality. The average CWE road score for the Box Creek Watershed is in the low range and indicates that little additional sediment is being generated and delivered to the stream channel from the road segments evaluated. The individual road segments evaluated in the watershed all rated *Low*. After this analysis, the Box Creek-Brush Creek Road was closed off permanently and graveled to minimize sediment delivery. Other watershed roads and skid trails were closed or obliterated.

Table 13. CWE Assessment Summary for Box Creek.

Surface Erosion Hazard	Mass Failure Hazard	Stream Temperature Rating	Hydrologic Risk Rating	Sediment Delivery Rating	Channel Stability Index Rafting
High	Moderate	High	Low	Low	Moderate

In addition to the CWE analysis, DEQ (1997) reported that while landslides occurred in the Box Creek watershed, none of those events was associated with management activities such as road building or timber harvest. In addition the majority of the natural landslides delivered sediment in the Box Lake area. The landslide prone areas are in sections with steeper relief and decomposed granitic soils.

The 1995 BURP data in the upper and lower watersheds indicated high percent fines but that beneficial uses were still supported. The middle reach of Box Creek is a steep gradient, step pool character stream that appears to be a very efficient transport reach for sediment and, thus, percent fines were low. 2003 BURP data indicate that stream habitat is of high quality and that recovery has occurred since the 1994 fire.

The canopy closure survey by IDL showed that 6 of 43 stream segments investigated had low shading values. The IDL did not determine whether or not the canopy closure was a result of land management activities or were *natural conditions* for those particular stream segments. The CWE assessment was done a year after the Blackwell Fire.

Temperature Data

Box Creek is listed on the 303(d) list for temperature. The upper Box Creek watershed was burnt in the Blackwell fire of 1994, decreasing riparian cover, increasing sediment delivery to the stream, and increasing instream temperatures. Although water quality impairment occurred as a result of this fire, these effects are natural and increased sedimentation, so increased water temperature is expected in the short term. Box Creek temperatures are also influenced by the release of water from Box Lake for irrigation purposes.

Box Creek did not violate the state cold water aquatic life standard in 2004 (Figure 46). Salmonid spawning temperatures were not met for the entire spawning period between March 15th and July 15th (Figure 47). 2004 temperatures from March 15th-May 8th were below 6° C. The temperature logging device was replaced with another logger on May 9th but malfunctioned and data was not collected again until July 9^{th,} close to the end of the salmonid spawning/incubation period. Temperatures were extrapolated by comparing data to Fall Creek. The daily average temperature during the period from July 9th-July 15th exceeded the 9°C criteria and likely exceeded it starting in mid-June.

As shown in Figure 48, Box Creek did not violate the state cold water aquatic life standard during 1995. Data was not available for the entire salmonid spawning season. Box Creek is managed for irrigation purposes, which can influence temperature due to a low flow regime during the summer months. The delivery of water to Box Creek would likely only influence spawning and incubation temperatures in late June and early July.

Box Creek was determined to be below the riparian canopy target. Thus, a TMDL was determined for Box Creek to help achieve salmonid spawning temperature criteria.

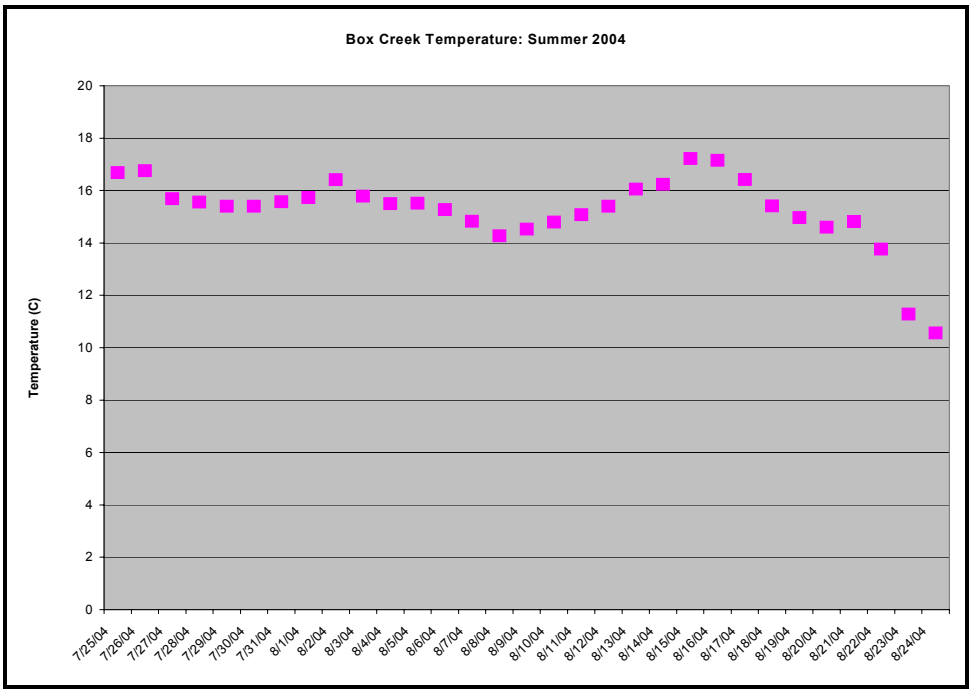

Figure 46. Box Creek 2004 Average Daily Summer Instream Temperatures.

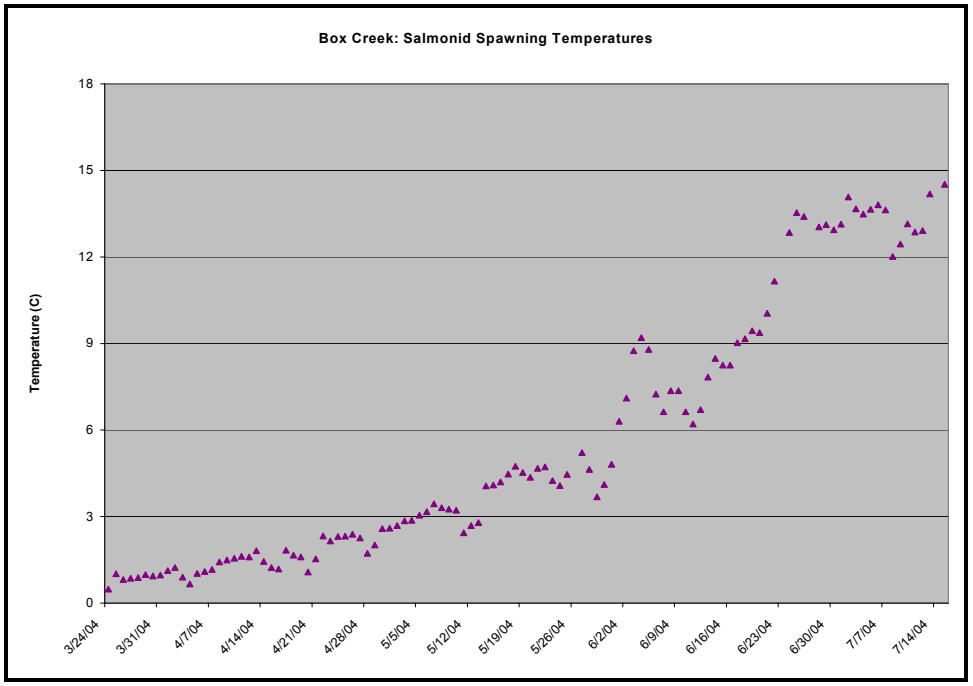

Figure 47. Box Creek 2004 Average Daily Salmonid Spawning Temperatures.

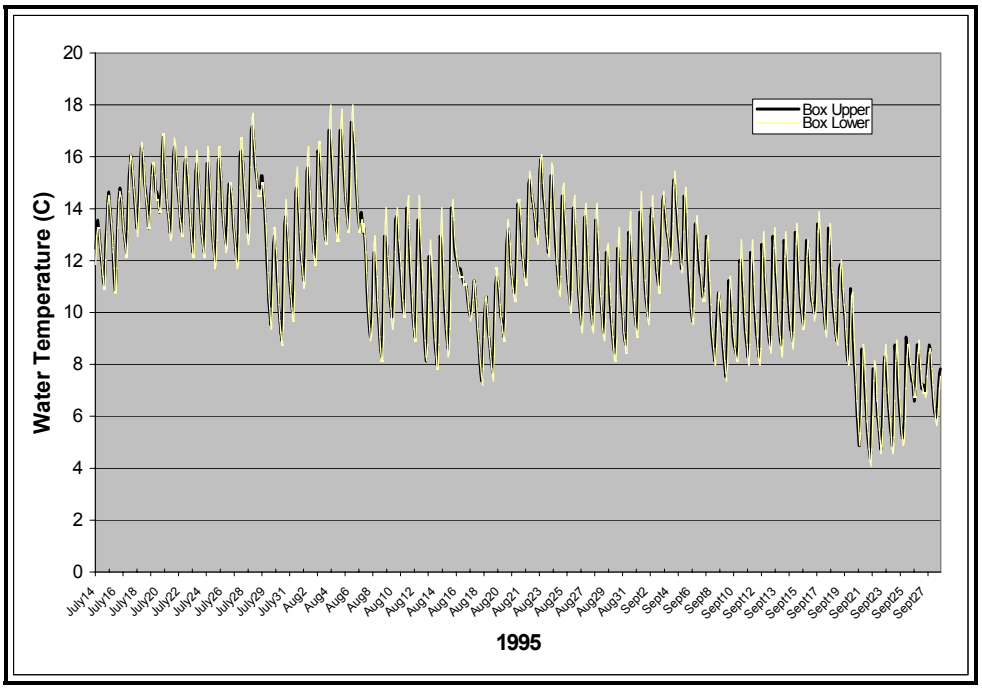

Figure 48. Box Creek 1995 Average Daily Summer Instream Temperatures.

Conclusions

Box Creek is listed on the 1998 303(d) list for temperature. Elevated temperatures in Box Creek may be affecting beneficial uses during spawning season. Stream inventories by DEQ have shown that beneficial uses are not impaired during the summer months. The riparian zone is continuing to improve following the Blackwell Fire of 1994. During salmonid spawning season, the temperature regime may be affected by the drawdown of Box Lake, but the extent of this influence cannot be ascertained without further study. Using aerial photos, pre and post burn vegetative cover were compared. Stream widths pre and post fire appeared to have stayed the same. A shading target of 82% was developed using shade curves for similar Douglas Fir-Grand Fir vegetative community types by averaging results for streams of a similar width and aspect from these TMDLs: the Walla Walla (ODEQ 2004b), Willamette (ODEQ 2004a), Mattole (CRWQCB 2002) and South Fork Clearwater (IDEQ 2002) TMDLs. Since the riparian canopy is not yet at the target cover amount, a TMDL was established.

Browns Pond

Browns Pond is a 98-acre pond that is used by Lake Fork Irrigation Company for irrigation water storage (Figure 50). At full pool, the pond stores between 1,600-1,800 acre-feet of water. The pond is fed by Lake Fork Creek and is a popular fishery that is stocked with rainbow trout. Located at 5,235' in the Lake Fork Creek subwatershed, the pond is upstream of Little Payette Lake (Figure 49). Browns Pond is surrounded by state land and the watershed is utilized for timber harvest.

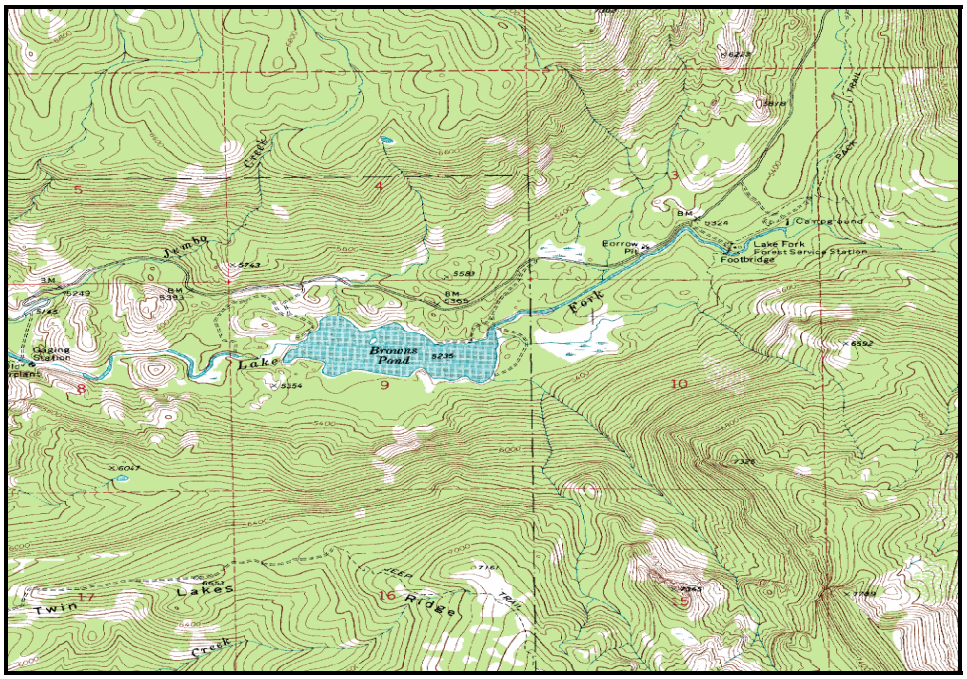

Figure 49. Browns Pond Subwatershed.

Figure 50. Browns Pond.

Conclusions

Browns Pond is listed on the 1998 303(d) list for habitat alteration because the dam is a barrier for migration of fish from below Browns Pond to the upper reaches of Lake Fork Creek. Browns Pond water level is regulated by irrigation, but typical summer drawdown conditions still leave sufficient habitat for fish. 2004 site visits did not find nuisance algal

growth or other evidence of beneficial use impairment. Browns Pond supports a rainbow trout fishery.

TMDLs are not done for habitat alteration because it is not a pollutant (see Section 5.1, Target Selection). Thus, a TMDL will not be done for Browns Pond.

Brush Creek

Brush Creek (Figure 52) originates at approximately 7,200 feet at Brush Lake and then flows in a westerly direction for 5 miles before entering the North Fork Payette River above Payette Lake. The Brush Creek watershed is located entirely within state and USFS managed public land and is entirely forested (Figure 51). Upper Brush Creek has a steep gradient characterized by a boulder-lined channel and a step/pool, cascade morphology. Brush Lake is managed for a trout trophy fishery. The watershed was burned in the 1994 Blackwell Fire and salvage timber harvest occurred afterwards. Timber harvest and sheep grazing occur in this watershed.

The Brush Creek drainage is predominantly underlain by highly and weakly weathered granitic rocks of the Idaho Batholith. To a lesser extent the drainage is underlain by loess. These granitics are typically divided, with the highly weathered material occurring along the lower elevations and dominating the main stem flood plain and lower tributary flood plains. The weakly weathered material occupies the uplands and ridgelines. The headwater area has substantial amounts of exposed bedrock, cliffs and talus slope (IDL 2003a).

The area is characterized by warm, dry summers and cold, wet winters. The majority of precipitation occurs as winter snowfall and spring rain. High-volume runoff occurs during spring snowmelt and major rain-on-snow events. Vegetation varies with elevation and aspect. Lower elevations support a mixed conifer forest stand with Douglas fir, hemlock, western larch and tamarack, with inclusions of Engleman spruce near streams and wetter areas. The presence of lodgepole pine, subalpine fir and pockets of spruce increases correspondingly with elevation and effective precipitation.

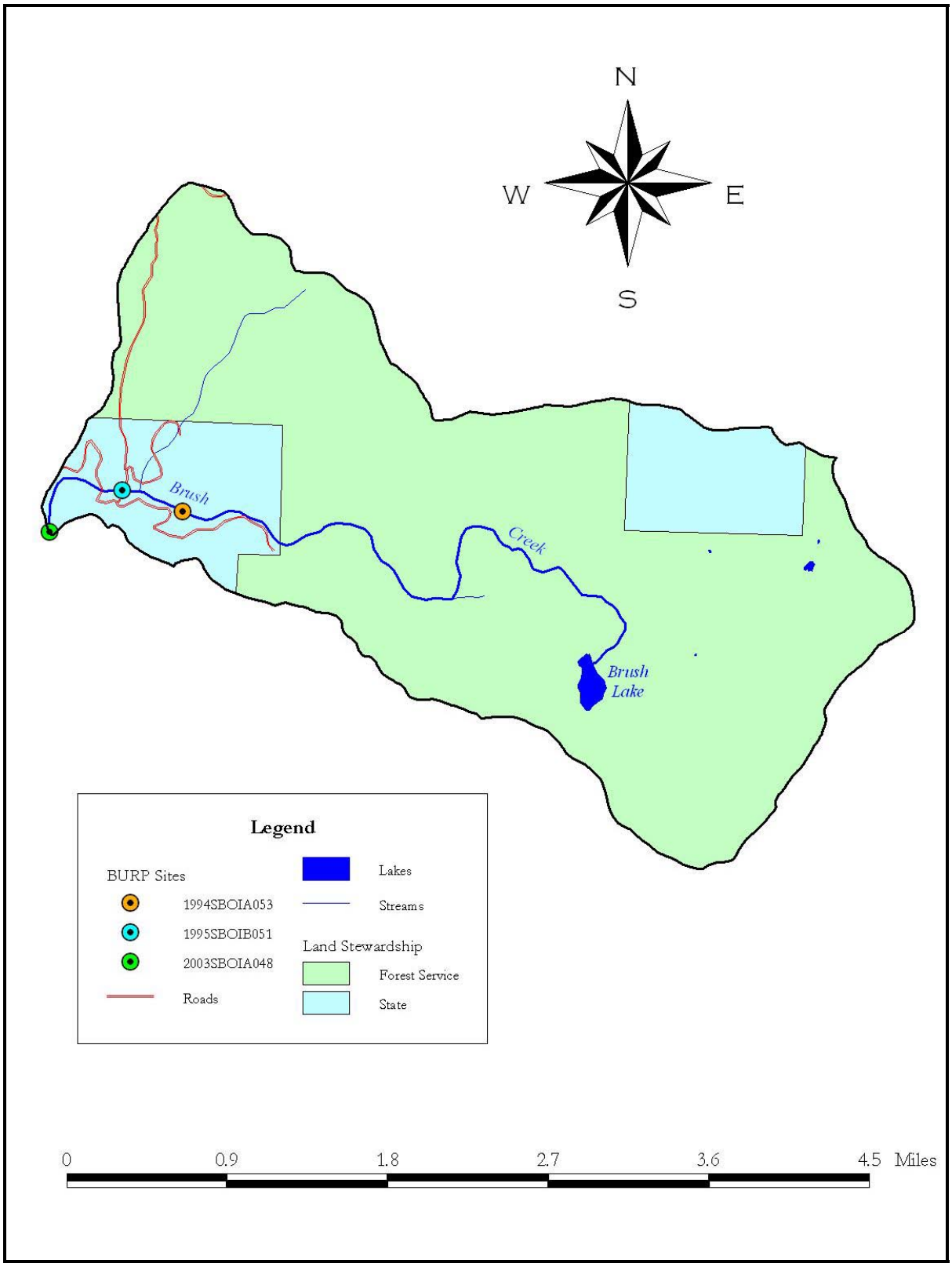

Figure 51. Brush Creek Monitoring Sites and Land Stewardship.

Figure 52. Brush Creek.

Flow Characteristics

Brush Creek average monthly flows are shown in Figure 53. Brush Creek tends to peak between April and Mid-June and reach base flow in mid-October.

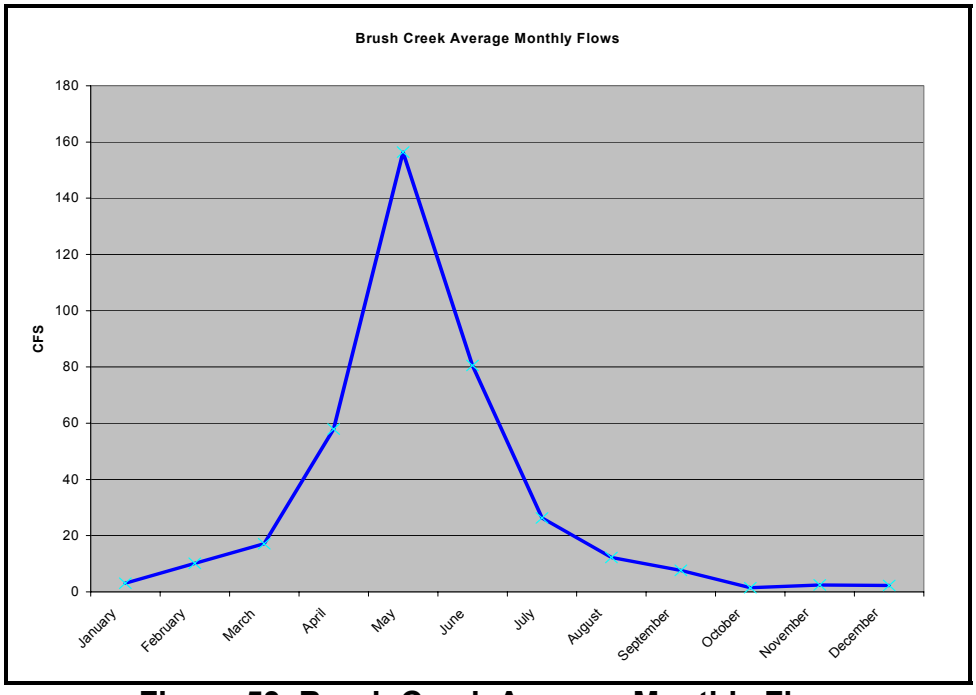

Figure 53. Brush Creek Average Monthly Flows.

Biological/Habitat Data

The Brush Creek watershed was burned in the 1994 Blackwell Fire, and salvage logging occurred in 1995 and 1996. DEQ (1997) reported that sediment was delivered to streams due

to timber harvest practices that took place within 50 feet of the stream, which was likely associated with salvage logging after the fire. The estimated amount of sediment delivered to the stream was 7 tons. As shown in the DEQ water body assessment scores, the habitat scores appear affected by the increased sedimentation of the stream and loss of riparian area due to fire (Table 14). The percent fines scores are shown because excess sediment delivery can adversely affect substrate composition and result in decreased diversity in the macroinvertebrate community, decreased pool quality and less robust fisheries. Percent fines remained low in each year measured (Table 15).

DEQ (1997) reported that no management caused landslides (i.e. associated with road building or timber harvest) have occurred in the Brush Creek watershed.

Over time, with a combination of road improvements/closures (Figure 54 shows an example) and riparian area regeneration, water quality has improved in the Brush Creek watershed. The 2003 DEQ BURP data shows that beneficial uses are not impaired. Electrofishing results showed more than three age classes of rainbow trout, including *young of the year,* which is indicative of a healthy fishery.

Table 14. Brush Creek: DEQ Water Body Assessment Scores.

Stream ID	SHI	SMI	SFI	Water Body Assessment Score	Beneficial Use Support Status
1994SBOIA053	1	3	No data	2	Full Support
1995SBOIB051	1	2	No data	1.5	Not Full Support
2003SBOIA048	3	2	3	2.67	Full Support

Table 15. Brush Creek: Percent fines*.

Stream ID	Stream	Percent Fines
1994SBOIA053	Brush Creek-lower reach	11
1995SBOIB051	Brush Creek-lower reach	3
2003SBOIA048	Brush Creek-lower reach	1

*DEQ BURP data

Figure 54. Brush Creek Road Closure.

Conclusions

Brush Creek is listed on the 1998 303(d) list for an unknown pollutant. Brush Creek was impacted from the 1994 Blackwell Fire and may also have shown impacts from historic logging practices and grazing, but in 2003, Brush Creek did not show impairment of beneficial uses and, thus, a TMDL is not necessary.

Clear Creek

Originating at 7,425 feet, Clear Creek (Figure 56) drains 31,523 acres over the course of 18 miles before emptying into the North Fork Payette River below Cascade Dam at 4,720 feet. Peak flows generally occur in May or June. The watershed is primarily forested (Figure 55).

Highly and weakly weathered granitic rocks of the Idaho Batholith predominantly underlie the Clear Creek drainage. To a lesser extent, fine-textured alluvium and glacial drift/till underlie the drainage. These granite rocks are typically divided, with the highly weathered material occurring along the lower elevations and dominating the main stem floodplain and lower tributary floodplains. The weakly weathered material occupies the uplands and ridgelines (IDL 2003b).

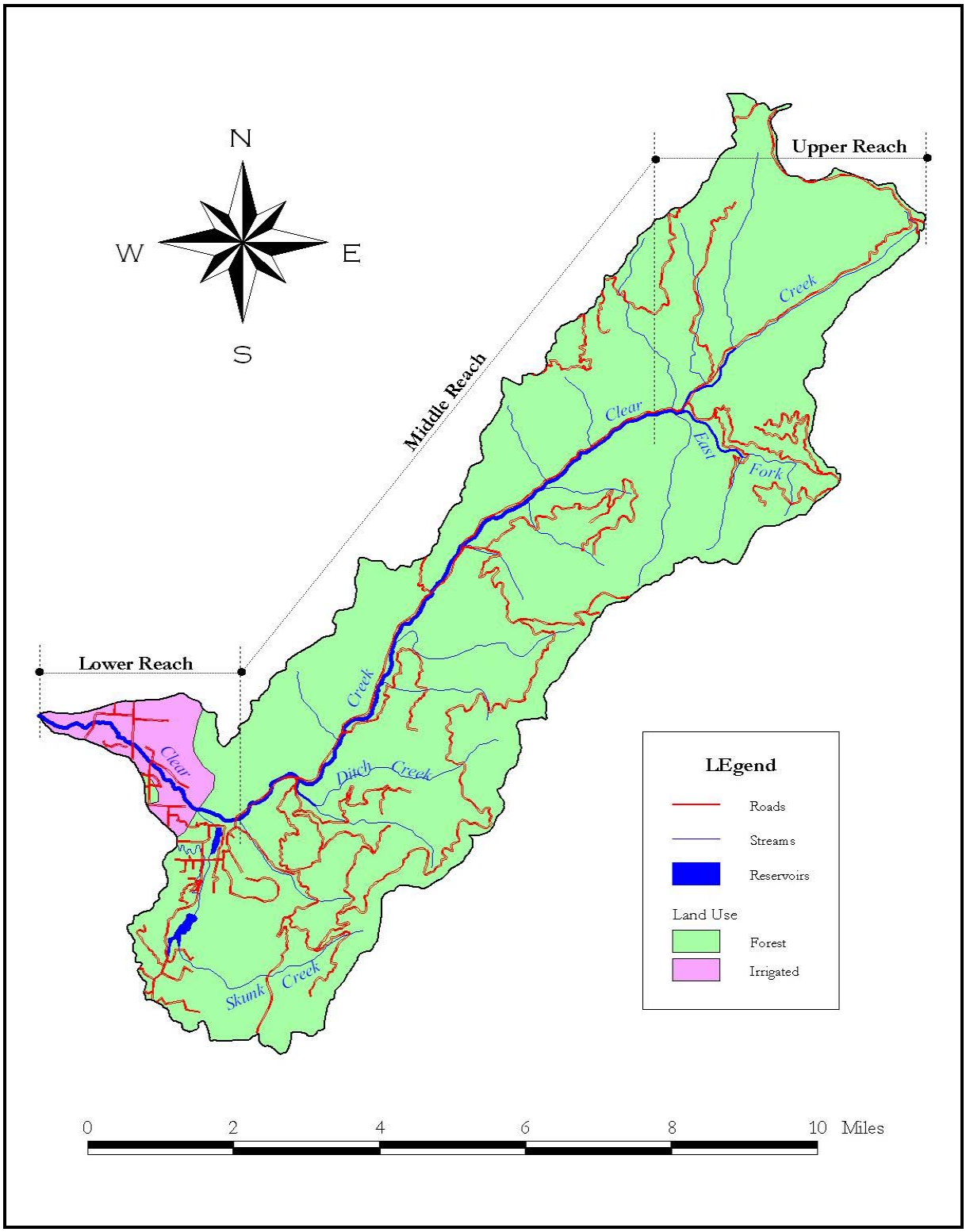

Figure 55. Clear Creek Hydrology and Land Use.

Figure 56. Clear Creek-Upper Reach.

Stream channels sampled on USFS managed land were mainly classed as Rosgen Type A5 and C5 (Rosgen 1996). Typically, A5 and C5 channels are incised in predominantly sandy materials, tend to have unstable bed and banks, and are very sensitive to induced changes in streamflow regime or in sediment supply (Rosgen 1996). Rosgen Type B channels sampled were classed as B4 and B5, which are considered relatively stable, and are not high sediment suppliers (Rosgen 1996). High bank stability at most sites, including type A channels, indicates factors are in place (large woody debris, riparian vegetation, sediment levels) that are conducive to stable streambanks.

Vegetation in the watershed varies with elevation and aspect. Southeast facing slopes at lower elevations are vegetated with forbs, grasses and ponderosa pine. On northwest slopes, and with increasing elevation, forest stands become denser with a greater number of coniferous species. The presence of Douglas fir, grand fir, western larch, and lodgepole pine increases with elevation and precipitation.

Clear Creek, a third order tributary, supports a cold water fishery of rainbow trout, mountain whitefish, and brook trout. Findings by the Idaho Fish and Game (IDFG) indicate remnant resident redband trout may be in the Clear Creek drainage. IDFG has determined that the wild rainbow trout found downstream in the Cabarton reach of the NF Payette River, 2-3 miles downstream of the mouth of Clear Creek, are spawning in Clear Creek in the spring (Anderson and others, 1987). Past surveys by district fisheries personnel have found rainbow trout in project area streams but brook trout are the predominant species in the watershed.

The lower and middle part of the reach is mainly private land with both active ranching and forestry being practiced as well as areas of rural residential subdivisions. Forest Capital Partners owns most of the middle portion (Boise Cascade previously owned the land). The headwaters are federally managed by the Boise National Forest (Figure 57).

Historically, Clear Creek was used as a route to take sheep to the South Fork Salmon River drainage. Sheep are still grazed near East Mountain during the summer. Approximately every third year, the sheep are brought down Forest Road 405, and held, sorted, and loaded at the junction of Forest Roads 405 and 409. In addition, timber harvest and cattle grazing (Figure 55) are still occurring in the drainage as well as recreational activities such as off-road vehicle use, camping, fishing, and hunting.

The majority of Forest Capital Partners lands (middle reach) have been harvested within the last 50 years. Records indicate that roughly 80 acres were harvested in 1950; 350 acres in 1968; 30 acres in 1970 or 1972; 1200 acres in 1980; and approximately 1800 acres in 1985. Harvest was accomplished using ground-based systems. Roughly 48 miles of road were constructed between 1940 to 1985 to facilitate this harvest (USFS 1999).

The USFS has also had several timber sales over the past 20 years. These are listed in Appendix H. The most recent sales are: 1. Summit Salvage Timber Sale - 1992 2. Clear Creek Summit Timber Sale - 1996 (274 acres; 0 miles road construction; 1.0 miles road reconstruction) 3. Far East Houselog Timber Sale - 1997 (Adjacent to East Mountain Lookout; 10 acres).

The Alpha Ditch Company operates the Alpha ditch, which diverts the majority of instream water from the lower end of Clear Creek during irrigation season. East Mountain and Herrick Reservoirs, two small impoundments, are located in this watershed.

Flow Characteristics

Stream flow information is sparse. The lower reach of Clear Creek is de-watered by an irrigation diversion on private land, starting in early summer until late fall. An estimated 90% of the summer base flow of Clear Creek is diverted from the existing channel. This diversion is unscreened, meaning it has the potential to trap nearly all juvenile salmonids migrating downstream until the flow is diverted back into the mainstem channel (USFS 1999).

Summer stream flow to Clear Creek is not replaced downstream from the Skunk Creek drainage. Skunk Creek is hydrologically modified by two impoundments. Irrigation ditch lines divert more than 90% of the flow from the Skunk Creek stream channel. Groundwater seepage does provide some flow downstream of the Skunk Creek confluence (USFS 1999).

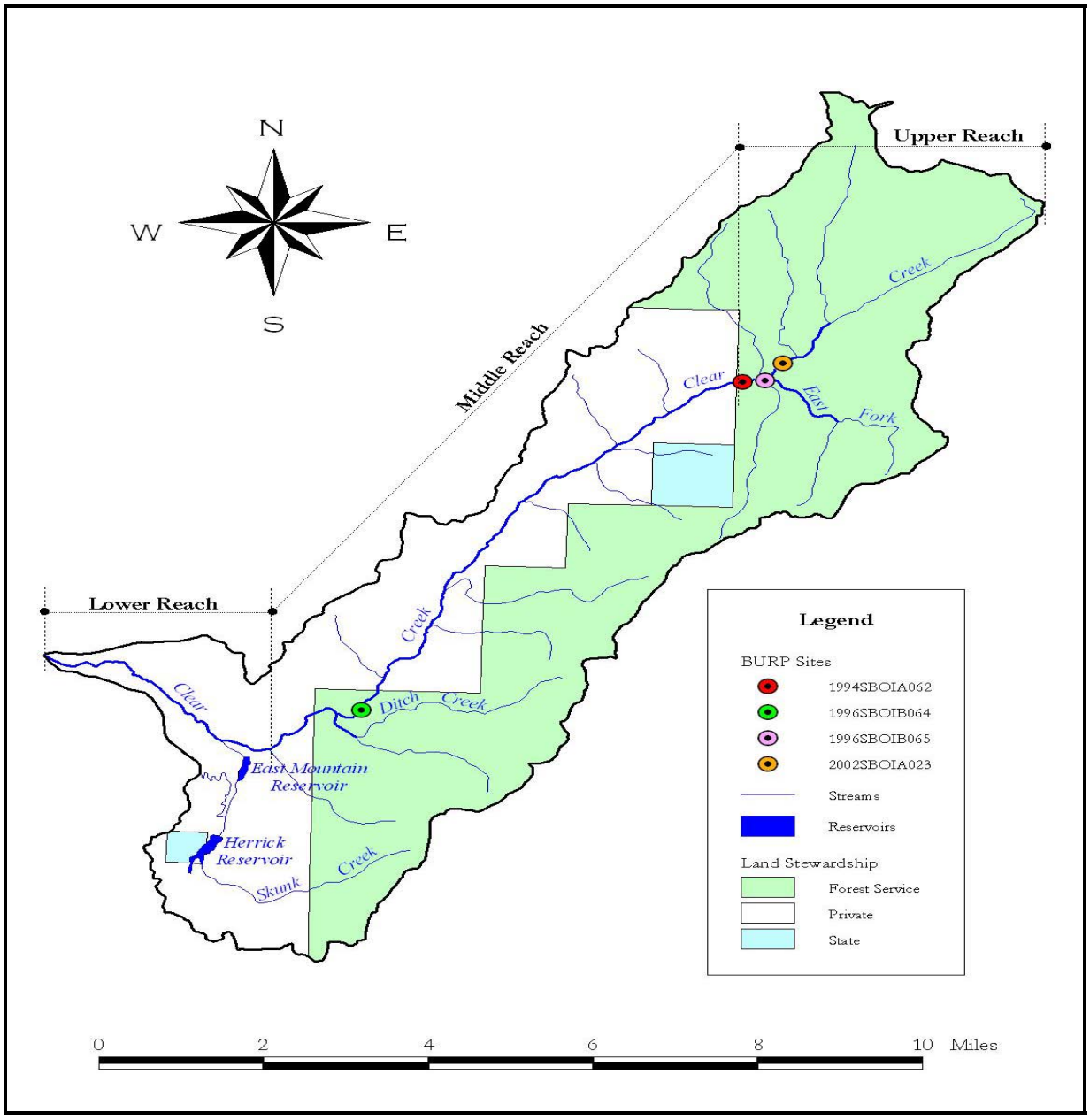

Figure 57. Land Ownership & Monitoring Sites in the Clear Creek Watershed.

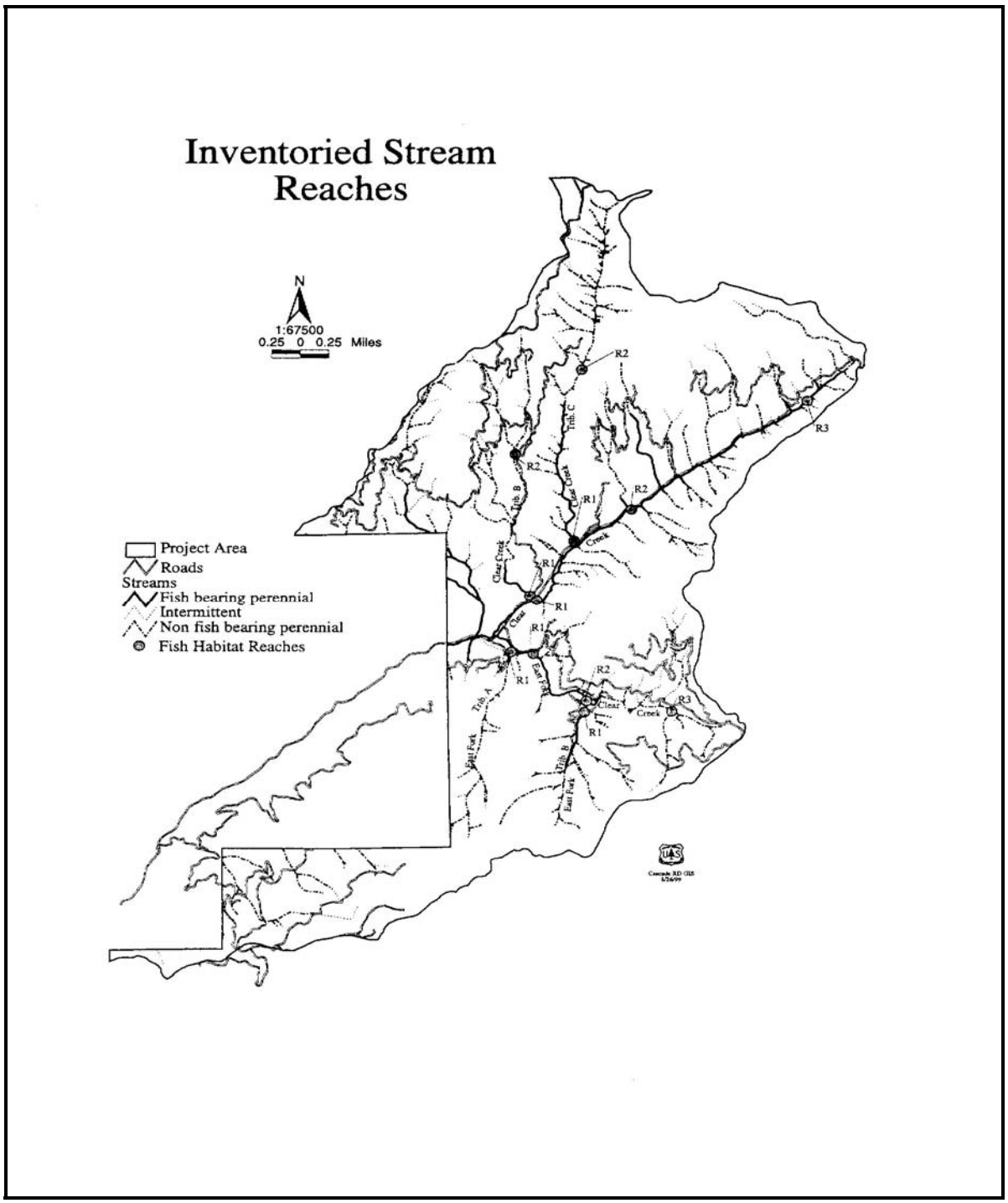

Figure 58. USFS Monitoring Sites in the Upper Clear Creek Watershed.

Upper Reach

Biological/Habitat Data

The User's Guide to Fish Habitat: Descriptions that Represent Natural Conditions in the Salmon River Basin (Overton, 1995) was used by the Boise National Forest to compare habitat data from comparable pristine streams to the conditions in the Clear Creek drainage (Figure 58). Streams are compared by Rosgen stream channel type.

For the purposes of this TMDL, the Upper Reach of Clear Creek is delineated as the USFS managed public land from Road 409 upstream (Figure 57). Currently beneficial uses do not appear impacted, but may be threatened by increasing sediment levels and conditions could be improved to further improve cold water fisheries. DEQ water body assessment scores showed that beneficial uses were not impaired in the upper reach.

Sediment

Elevated fines in pool tailouts at Clear Creek and Clear Creek tributary sites indicate sediment is impairing spawning habitat in that portion of the drainage (Tables 16-18). Lower pool tailout fines at sites in the East Fork Clear Creek watershed indicate spawning habitat to be in better condition there. Though field observation, width depth ratio, width max depth ratio, and bank stability site data indicated that the desired fish habitat conditions are currently being met, and channels are for the most part not degraded, consistently elevated percent fines in Clear Creek and tributary sites in all channel types (Table 16), and evidence of degradation in the sensitive C5 channel site, indicate sediment levels may be approaching those leading to channel degradation.

As shown in the tables below, Clear Creek has percent fines greater than the 37% mean typically found in C channel plutonic streams and the 23% found in B channel plutonic streams (Overton 1995) in undisturbed areas. Most of the Clear Creek surface fines measurements were taken in B channels.

Table 17 includes the relationship between percent fines and rainbow trout egg-to-fry survival. Elevated pool tail out fines at all Clear Creek and Clear Creek tributary sites indicate that sediment is impairing spawning habitat in these streams (Tables 16-18). Spawning fines at these sites range from 38 to 81% which equates to approximately 44% to 0% egg-to-fry survival, respectively. Conditions in the lower reaches of the East Fork of Clear Creek show spawning habitat comparable to pristine sites.

Table 16. Median Percent fines score for Clear Creek Watershed (USFS 1999).

Stream	Median Percent Fines
Clear Creek	43
East Fork Clear Creek	26
Other Clear Creek Tributaries	61